REMARKS

Claims 1-7 and 17-20 were examined. Claims 1, 6, and 17 are amended. Claims 1-7 and 17-20 remain in the application.

The Patent Office rejects claims 1-7, and 17-20 under 35 U.S.C. §112, first paragraph. The Patent Office rejects claims 1-4, 6-7, and 17-20 under 35 U.S.C. § 102(b). Reconsideration of the rejected claims is respectfully requested in view of the above amendments and the following remarks.

A. Clarification of the Specification

The Patent Office requests clarification of the language "process conversion step" added to the independent claims in conjunction with the amendment and response filed on August 23, 2000. Although Applicants believe such language to be clear from the specification, Applicants amend this language to describe an environment where radicals react with a substrate in a "film conversion step". The amendment accommodates the Patent Office's request for clarity in an effort to advance prosecution. Applicants believe the "process conversion step" language is accepted terminology in the art as well. Applicants also emphasize that the amendment to the independent claims is not a narrowing amendment.

As support for the "film conversion step" language in the Application, reference is representatively made to Figures 1-2 and the accompanying text. There is described a bombardment by a plasma of, for example, substantially nitrogen radicals.

> In one embodiment, SiO_2 layer 110 is a gate oxide and the plasma is a nitrogen plasma incorporating nitrogen into the gate oxide to act as a barrier layer. Figure 2 shows substrate 100 after the reaction between the radicals of the plasma and $Si0_2$ layer 110. Figure 2 schematically illustrates the formation of, for example, a nitrogen-containing material or layer 120 overlying SiO_2 layer 110. A nitrogen plasma of nitrogen radicals (N^*) reacts primarily with the oxide or displaces oxygen at the surface of SiO_2 layer 110 to yield a dielectric layer (i.e., SiO_2 layer 110 plus nitrogen-containing material or layer 120) having a significantly greater concentration of nitrogen-containing material at the surface of the dielectric layer as opposed to interface 105 between the dielectric layer and substrate 100.
>
> . . . .
>
> It is appreciated that the invention is not limited to a process that results in a strict placement of a film or layer at the reaction surface, i.e., that the plasma

> reaction takes place in such a way to produce distinct layers of plasma-containing material and oxide. Instead, as will be discussed in detail below, in certain embodiments, the radicals of the plasma react and interact, for example, within the oxide during the exposure of the radicals to the reaction surface. In the case of a nitridation of a gate oxide, for example, the nitrogen-containing material is produced effectively in or on SiO_2 layer 110 by exposing SiO_2 layer 110 to a plasma of predominantly N^* radicals. One theory is that the N^* radicals displace oxygen atoms in SiO_2 layer to form Si_3N_4 and $Si_xO_yN_z$ material.

Application at page 9, line 16 through page 10, line 19. In this one example, what is described is a conversion of an SiO_2 film into a film containing SiO_2 and Si_3N_4 and $Si_xO_yN_z$ species. The conversion is brought about by the introduction of nitrogen radicals into the film formation environment.

Applicants believe the amendment to independent claims 1, 6 and 17 to describe an environment where radicals react with a substrate in a "film conversion step" is sufficiently described in the application and recites generally accepted terminology in the context of the field of the claimed invention.

B. 35 U.S.C. §112, First Paragraph: Rejection of Claims 1-7 & 17-20

The Patent Office rejects claims 1-7 and 17-20 under 35 U.S.C. §112, first paragraph as containing subject matter that was not described in the specification to reasonably convey that the inventors had possession of the claimed invention. The Patent Office refers to the "process conversion step" language of independent claims 1, 6 and 17. Applicants amend claims 1, 6 and 17 in a non-narrowing fashion to describe that radicals react with a substrate in "film conversion step." Applicants believe the "film conversion step" language is sufficiently supported in the application and reference the above-quoted language as an example.

For the above-stated reasons, Applicants respectfully request that the Patent Office withdraw the rejection to claims 1-7 and 17-20 under 35 U.S.C. §112, first paragraph.

C. 35 U.S.C. §102(b): Rejection of Claims 1-4, 6 & 7

The Patent Office rejects claims 1-4, 6 and 7 under 35 U.S.C. §102(b) as anticipated by Matsuo. Matsuo describes the role of nitrogen (N_2) addition on CF_4/O_2 plasma chemical dry etching. Matsuo does not describe film conversion. Further, Matsuo, at Section III.A.2. (Etch Rates Versus Tube Length), referring to Figure 4, teaches that, with the addition of nitrogen, etch

rates drop with increased tube length. The best etch results are seen with "zero tube length". Thus, in this regard, Matsuo teaches away from separating a plasma and an etch chamber.

Applicant's understanding of Matsuo, as stated in the August 23, 2000, Amendment and Response to Office Action, is that the reference teaches combining nitrogen with O_2 and CF_4 such that the nitrogen reacts with O_2 in a manner to enhance a plasma. Matsuo does not describe nitrogen radicals that react with a substrate in a film conversion step.

Independent claim 1 is not anticipated by Matsuo, because Matsuo does not describe an apparatus including a second reaction chamber adapted to house a substrate "for film formation processing", or coupling a first reaction chamber to a second reaction chamber with a substrate site separated by a distance equivalent to the lifetime of the ions at a plasma generation rate such that the radicals react with the substrate in a film conversion step. According to claim 1, with the distance between the first reaction chamber and the substrate site separated by the lifetime of the ions, the ions available at the contact site are minimized so that predominantly radicals are available for reaction with a substrate as described in the application.

Matsuo describes etching, not film formation environment. Matsuo teaches no separation is best between a plasma generator and an etch chamber. Finally, Matsuo does not describe the coupling and separation between chambers such that radicals generated in one chamber will react with a substrate in a film conversion step while available ions are minimized.

For the above-stated reasons, Applicants assert that independent claim 1 is not anticipated by Matsuo. Claims 2-5 depend from claim 1 and therefore contain all the limitations of that claim. For at least the reasons stated with respect to claim 1, claims 2-5 are not anticipated by Matsuo. Applicants respectfully request that the Patent Office withdraw the rejection to claims 1-5 under 35 U.S.C. §102(b).

Independent claim 6 is also not anticipated by Matsuo, because Matsuo does not describe an apparatus including a second reaction chamber "for film formation processing" or means for providing a plasma from a nitrogen gas to the reaction chamber free of ions such that the radicals react with a substrate in a film conversion step. As noted above with respect to claim 1, Matsuo describes etching, not a film formation environment, and does not describe radicals reacting with a substrate in a film conversion step while ions are minimized.

For the above-stated reasons, independent claim 6 is not anticipated by Matsuo. Claim 7 depends from claim 6 and contains all the limitations of that claim. For at least the reasons stated with respect to claim 6, claim 7 is not anticipated by Matsuo.

Applicants respectfully request the Patent Office withdraw the rejection to claims 1-4 and 6-7 under 35 U.S.C. § 102(b).

D. 35 U.S.C. §102(b): Rejection of Claims 17-20

The Patent Office rejects claims 17-20 under 35 U.S.C. § 102(b) as anticipated by U.S. Patent No. 5,082,517 issued to Moslehi (Moslehi). As pointed out in the Amendment and Response to Office Action filed August 22, 2000, Moslehi describes a system for controlling a plasma density in a reaction chamber.

> "Consequently, there is a need for a device that adjustably controls the plasma-generating electromagnetic power that a fabrication process gas receives to produce a process plasma consisting of activated charged and neutral species."

Col. 2, lines 37-41 (emphasis added). Moslehi wants charged and neutral species.

Independent claim 17 is not anticipated by Moslehi, because Moslehi does not describe a system controller comprising a memory and a computer-readable program in the memory comprising instructions for controlling a gas source and an energy source to deliver a plasma from a first chamber to a second chamber substantially free of ions ("charged species") to react with a substrate in the second chamber in a film conversion step. Moslehi teaches delivering both charged and neutral species to a process chamber. Independent claim 17 teaches minimizing "charged" species by separating the plasma generation chamber ("first chamber") from a substrate site by a distance equivalent to the lifetime of ions.

For the above-stated reasons, claim 17 is not anticipated by Moslehi. Claims 18-20 depend from claim 17 and therefore contain all the limitations of that claim. For the reasons stated with respect to claim 17, claims 18-20 are not anticipated by Moslehi.

Applicants respectfully request the Patent Office withdraw the rejection to claims 17-20 under 35 U.S.C. §102(b).

CONCLUSION

In view of the foregoing, it is believed that all claims now pending patentably define the subject invention over the prior art of record and are in condition for allowance and such action is earnestly solicited at the earliest possible date.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Dated: 3/12/01

William Thomas Babbitt, Reg. No. 39,591

12400 Wilshire Boulevard
Seventh Floor
Los Angeles, CA 90025
(310) 207-3800

CERTIFICATE OF MAILING:

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231 on March 12, 2001.

Nedy Colleen 3/12/01

Nedy Colleen Date

Attachment: Version with Markings to Show Changes Made

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

1. (Twice Amended) An apparatus comprising:

a first reaction chamber;

a gas source coupled to the first reaction chamber to supply a nitrogen gas to the first reaction chamber;

an excitation energy source coupled to the first reaction chamber to generate a nitrogen plasma comprising ions and radicals from the nitrogen gas; and

a second reaction chamber adapted to house a substrate for film formation at a site in the second reaction chamber,

wherein the first reaction chamber is coupled to the second reaction chamber and separated from the substrate site by a distance equivalent to the lifetime of the ions at a plasma generation rate such that the radicals react with the substrate in a ~~process~~ film conversion step.

6. (Twice Amended) An apparatus for exposing a substrate to plasma, comprising:

a first reaction chamber;

means for supplying a nitrogen gas to the first reaction chamber;

means for generating a plasma from the nitrogen gas, the plasma comprising ions and radicals;

a second reaction chamber having means for housing a substrate for film formation processing; and

means for providing the plasma to the second reaction chamber substantially free of ions such that the radicals react with a substrate in a process conversion step.

17. (Twice Amended) A system for reacting a plasma with a substrate, comprising:

a first chamber;

a gas source coupled to the first chamber comprising constituents adapted to react with a substrate;

an energy source coupled to the first chamber;

a second chamber configured to house a substrate for film formation processing;

a system controller configured to control the introduction of a gas from the gas source into the first chamber and to control the introduction of an energy from the energy source; and

a memory coupled to the controller comprising a computer-readable medium having a computer-readable program embodied therein for directing operation of the system, the computer-readable program comprising:

instructions for controlling the gas source and the energy source to convert a portion of a gas supplied by the gas source into a plasma comprising plasma ions and radicals and to deliver the plasma to the second chamber substantially free of ions to react with a substrate in the second chamber in a ~~process~~ film conversion step.